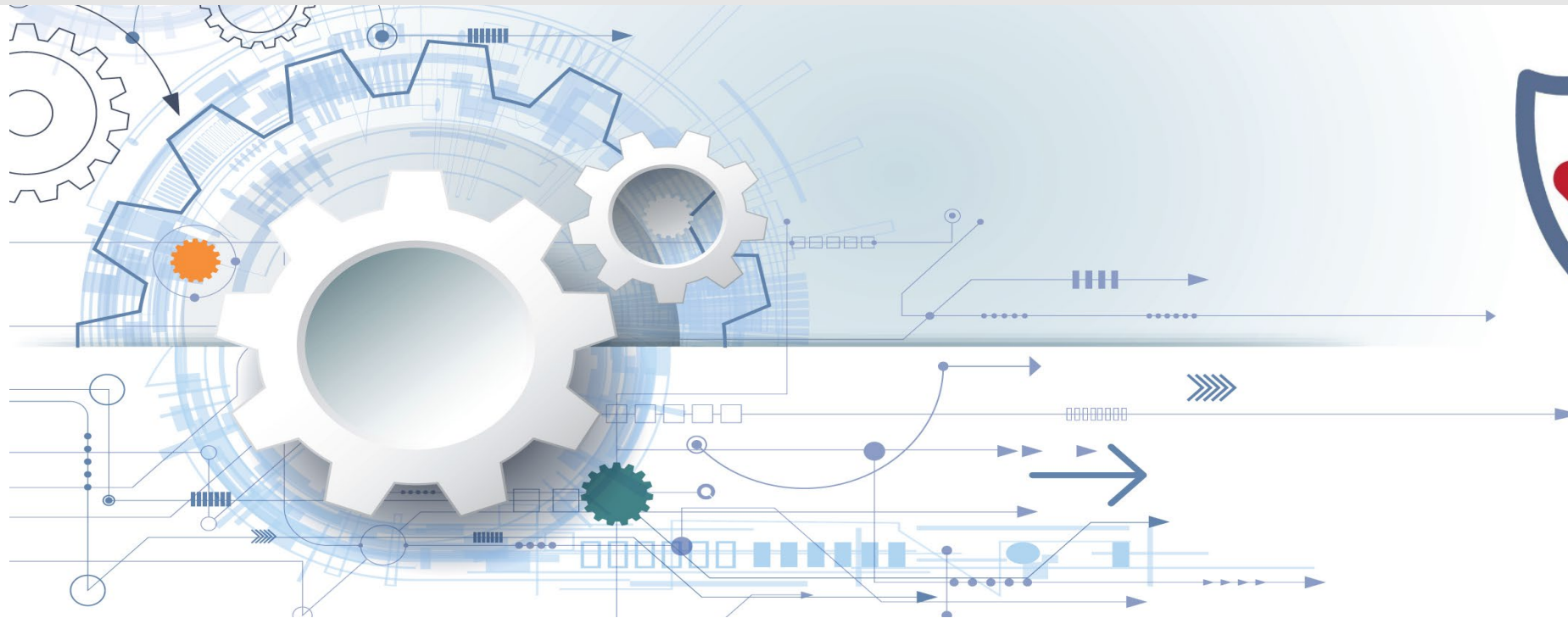


Is your Vibration Monitoring Program Solving Equipment Reliability?



VIATC 

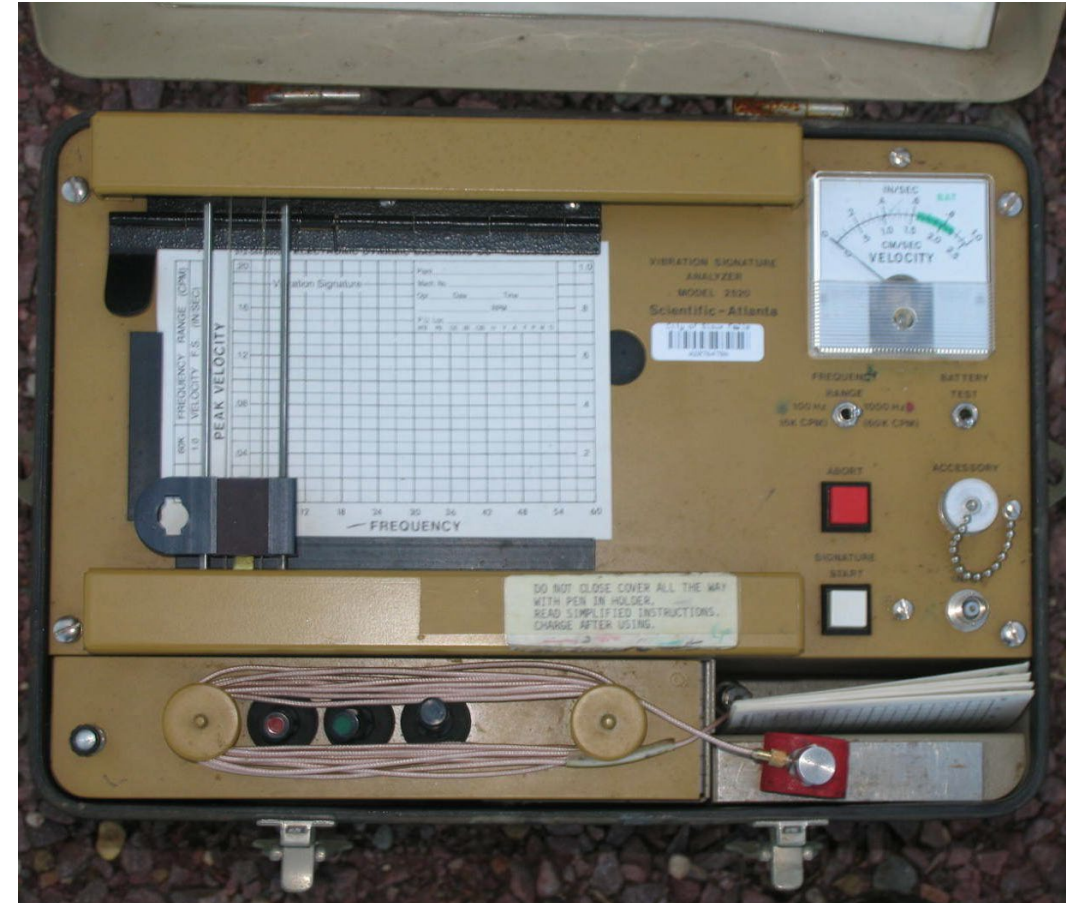
COVINGTON, KENTUCKY

TRAINING
CONFERENCE
& EXPO

AUGUST 7-9, 2024

Keynote Session

Predictive Maintenance (PdM) Vibration Monitoring - Then



Predictive Maintenance (PdM) Vibration Monitoring - Then

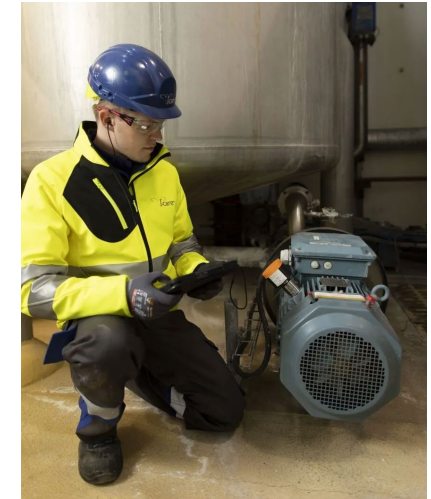
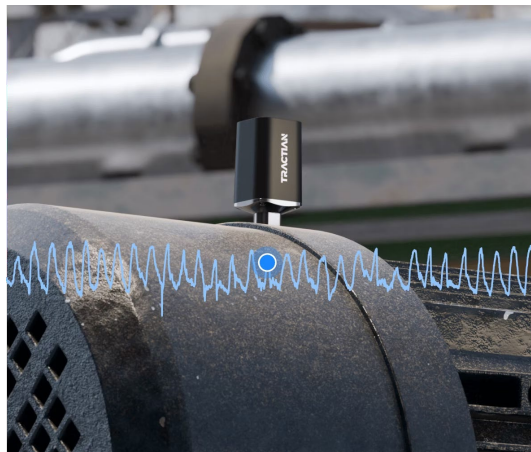
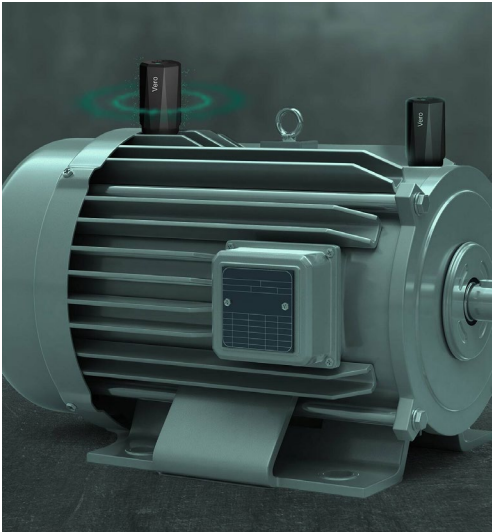


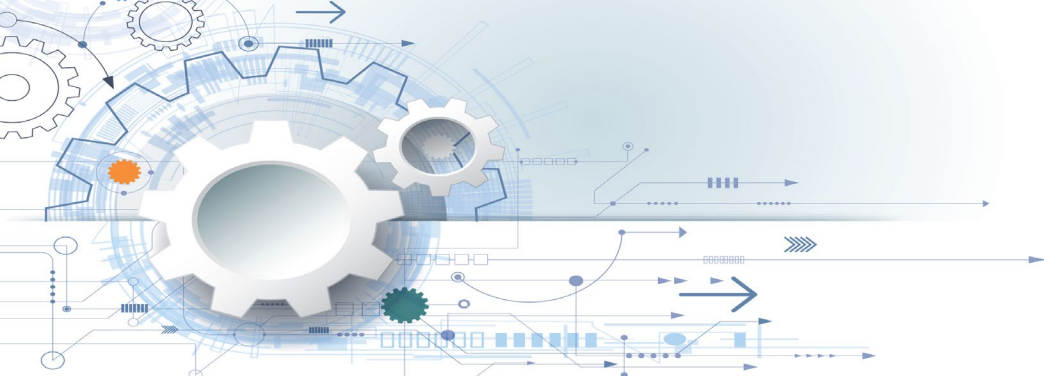
Predictive Maintenance (PdM) Vibration Monitoring - Now

Industry 4.0
AI – Artificial Intelligence
Machine Learning
IIoT

Prescriptive Analysis
Real Time Monitoring
SaaS Solutions
Cloud-based

Mobile data collection - Bluetooth enabled

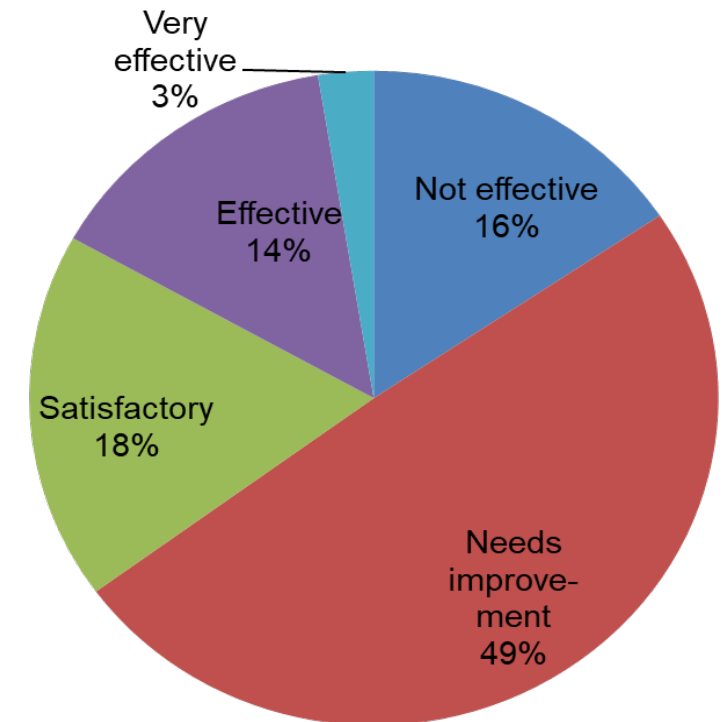




Complicating Factors

Overall PdM program performance

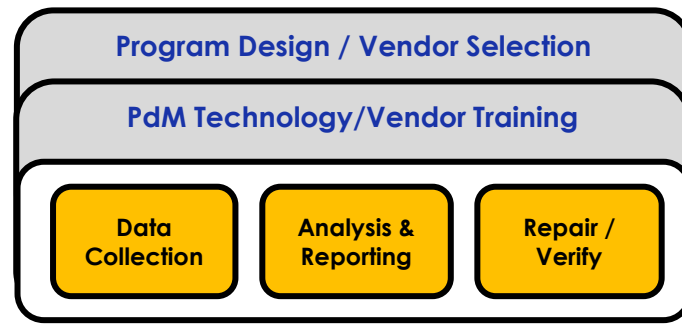
- Many PdM Programs are ineffective (65/35%), understanding why requires an assessment
- Most programs need to improve data analytics, program management, KPIs and metrics
- **Many programs desire to push for the next generation PdM, IIoT, Industry 4.0, AI, Predictive Analytics and machine learning.** However, without a solid program foundation, identifying failures may continue, in most cases, more efficiently but improvements in reliability will not be increased.



©Plant Services, PdM Survey

Effective Failure Management

Traditional PdM Program



Cost Avoidance (Soft)

Typical Traditional Setup

- Included assets are not risk based
- Data collection frequencies assigned globally
- Alarm thresholds assigned globally
- Minimal changes / optimization made throughout life of the program

“One size fits all – Celebrating Finding Failures”



Failure Management versus Reliability?

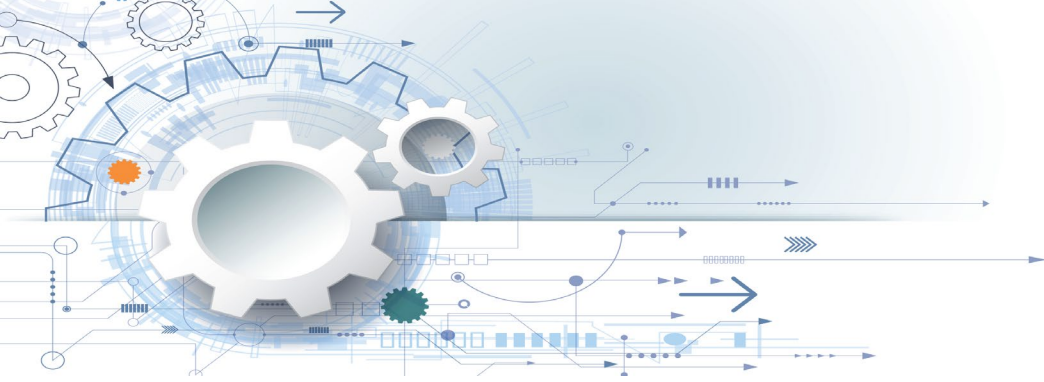
Reliability is defined as the ability of an apparatus, machine, or system to consistently perform its intended or required function or mission, on demand and *without degradation or failure*.

Failure management is a critical need facilitated through your PdM and PM efforts. Managing failures provides early work identification, helps control / eliminate unplanned downtime, and reduce costs.

When asked, most people say PdM is a reliability program. However, PdM programs alone were not designed to improve reliability, rather the design is focused on detecting and effectively managing failures.

Not trying to be controversial, just showing the relationship between failure management and reliability improvements. We don't need to argue about this but rather understand how to drive true reliability from the program.

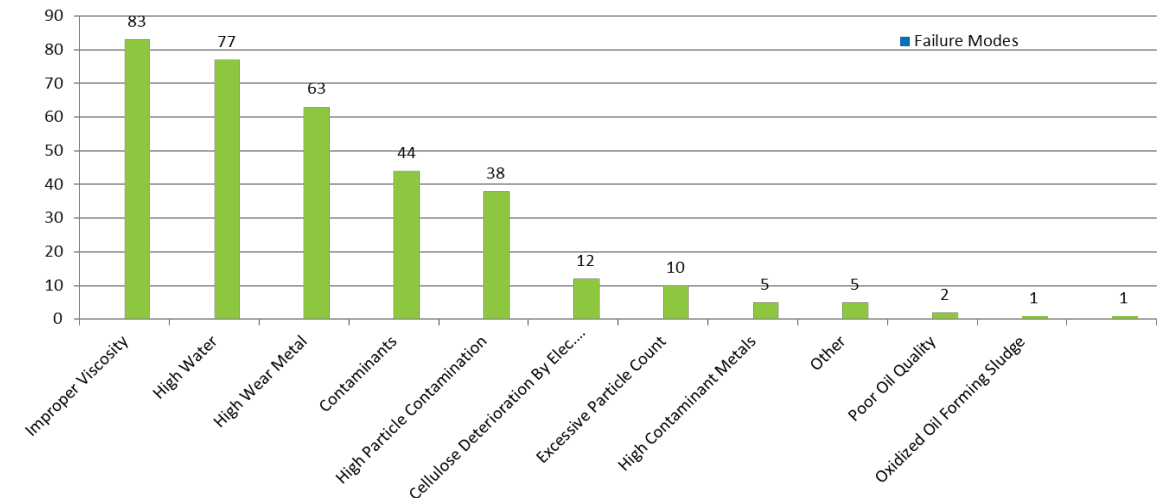
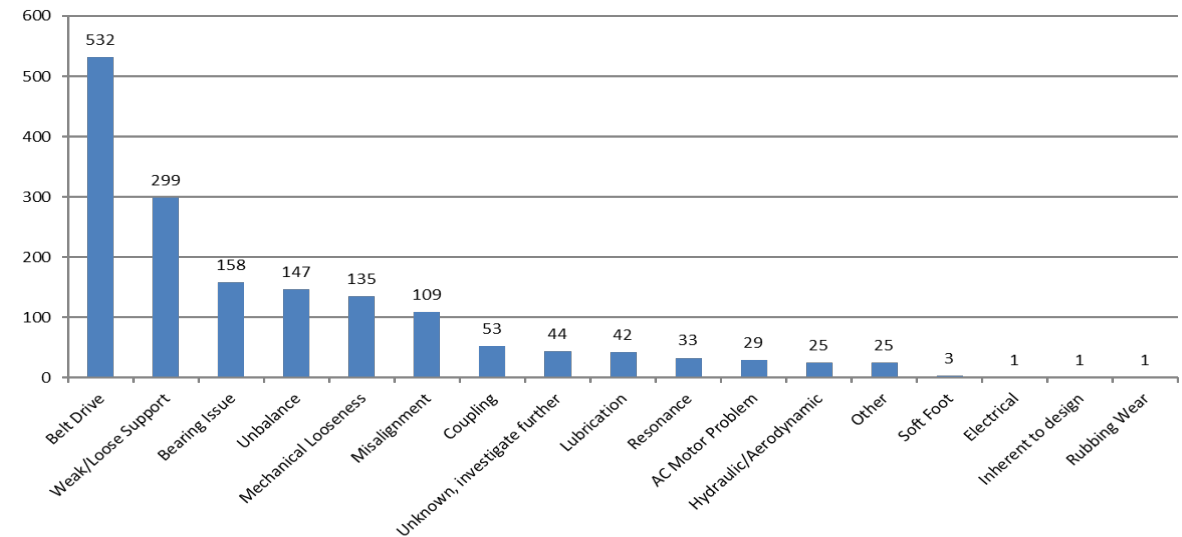
So, while the failures are predictable, the result is not necessarily improved reliability.



Trending the failures your program is finding?

Many of the failure modes predicted by PdM reoccur over and over across the asset base.

When looking at each problem found through PdM, the challenge to our Analyst is to not limit their efforts to detection and recommended repairs. Our analyst may need to take a deeper dive to understand the root cause of each problems or symptom, as best as they can. At a minimum, working closely with the Reliability Engineers to partner on root causes.



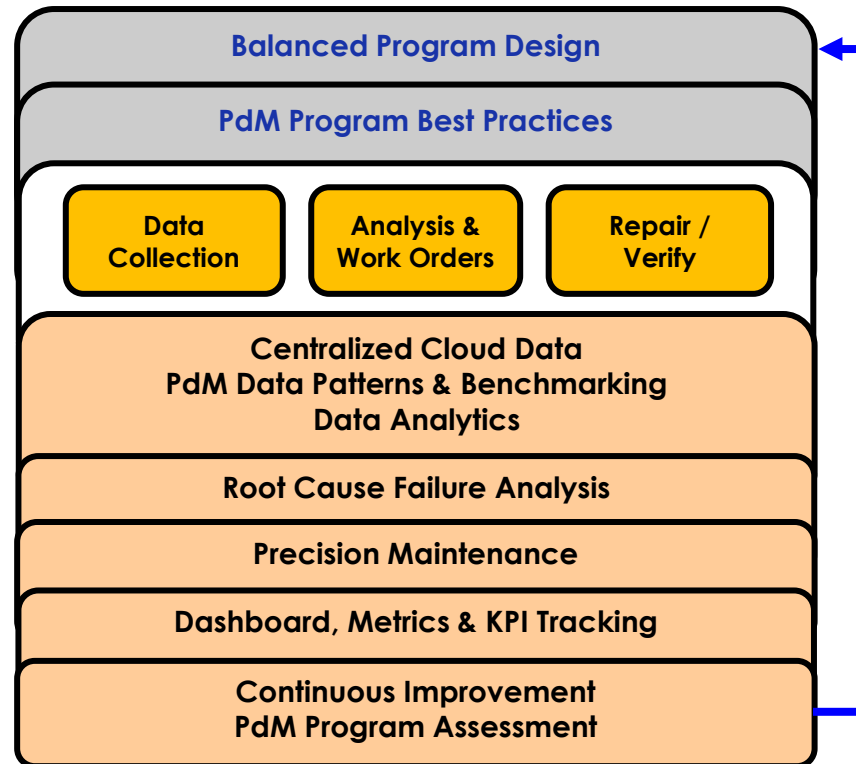


Changing the PdM paradigm – driving reliability

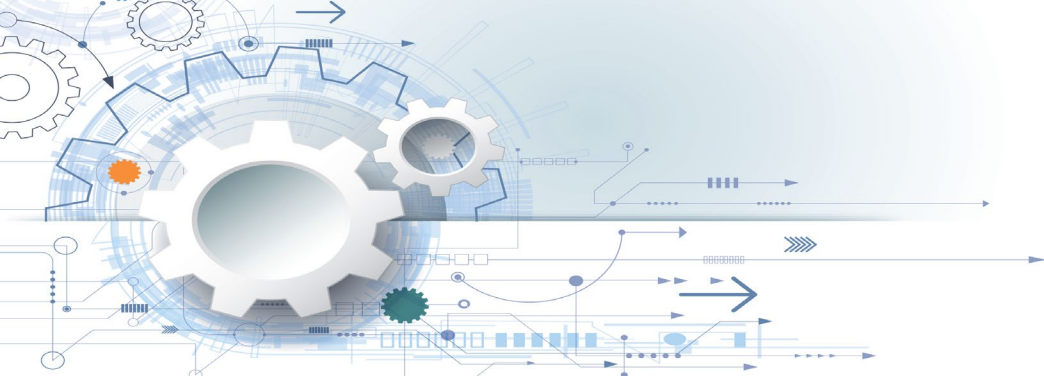
Enhanced Predictive Maintenance (ePdM)

- Combines a properly designed, installed and managed deployment of predictive technologies with standard processes and statistical analysis to identify and eliminate most reoccurring failures at their root.
- Adds failure trending (FRACAS), bad actor triggers and root cause failure analysis (RCFA), as key components of your PdM program.
- Adds a precision approach to your maintenance efforts through proper training, techniques and tools.
- Not focused just on individual asset failures but failure patterns that affect equipment condition across all assets / components / sub-systems / types.
- *Reliability gains are driven from eliminating failures rather than predicting them.*

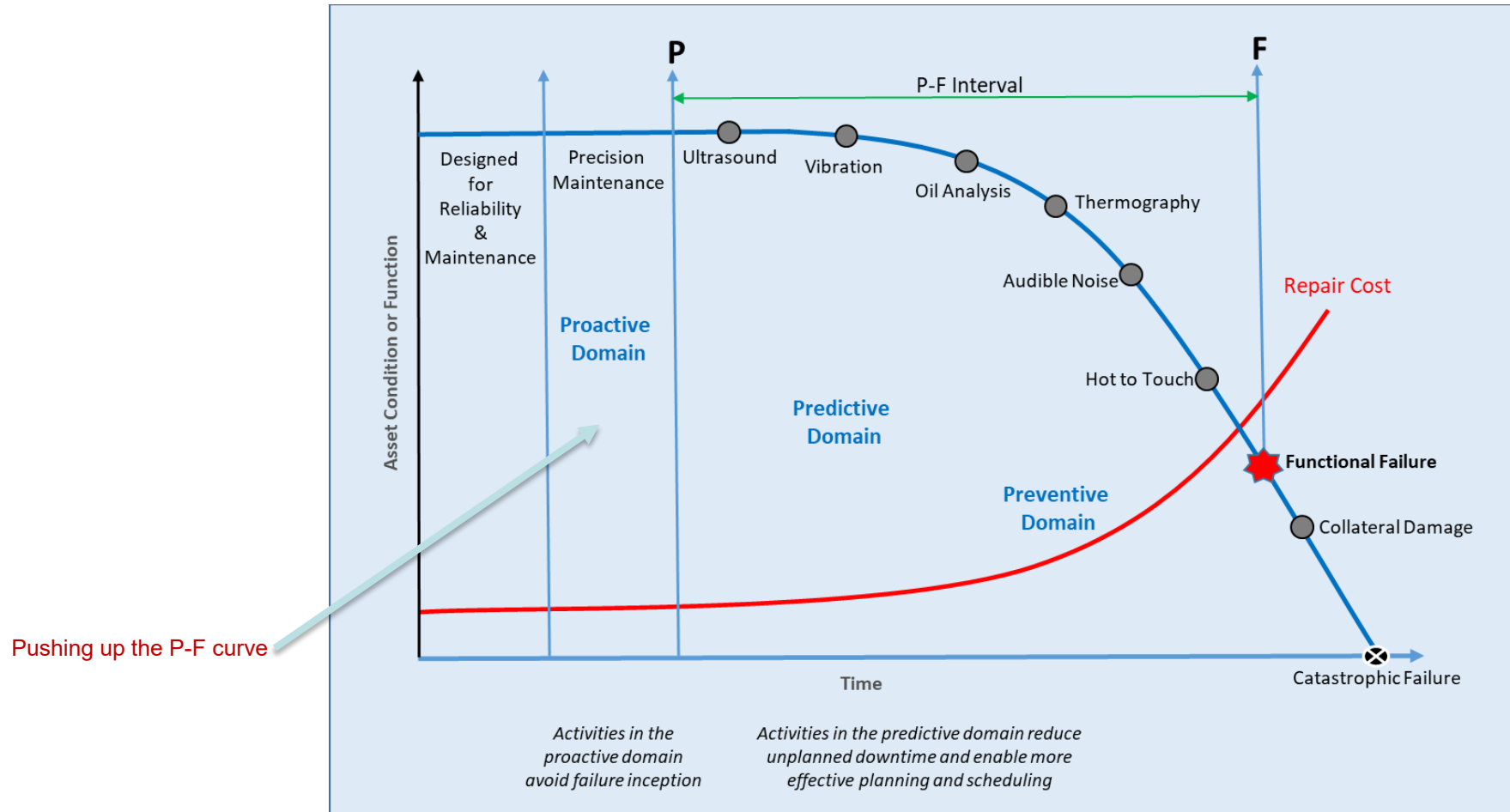
Failure Elimination

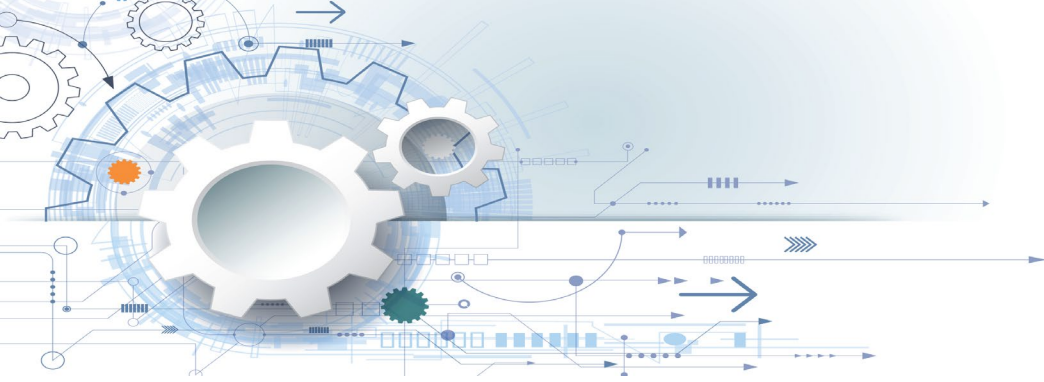


**Cost Savings
(Hard)**

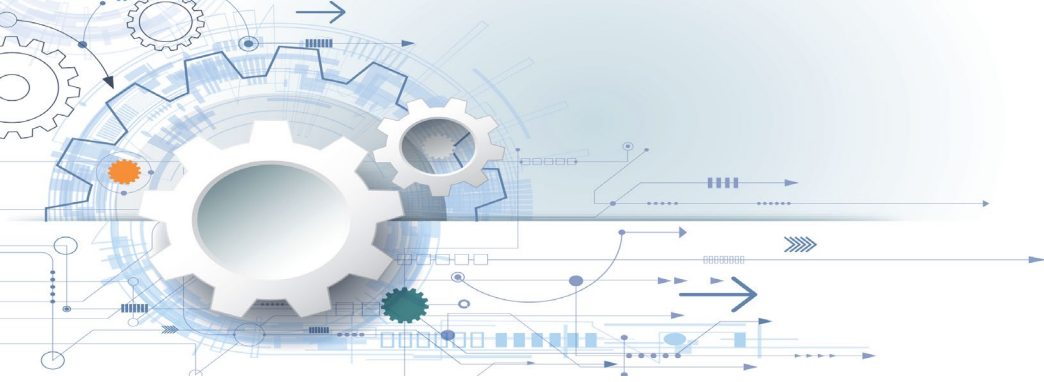


The program's mission statement: "early failure detection while adding the trending, analytics and root cause to eliminate the reoccurring failure patterns. If we achieve this mission, we will essentially prevent failures from occurring, adding reliability to the facility's operations."

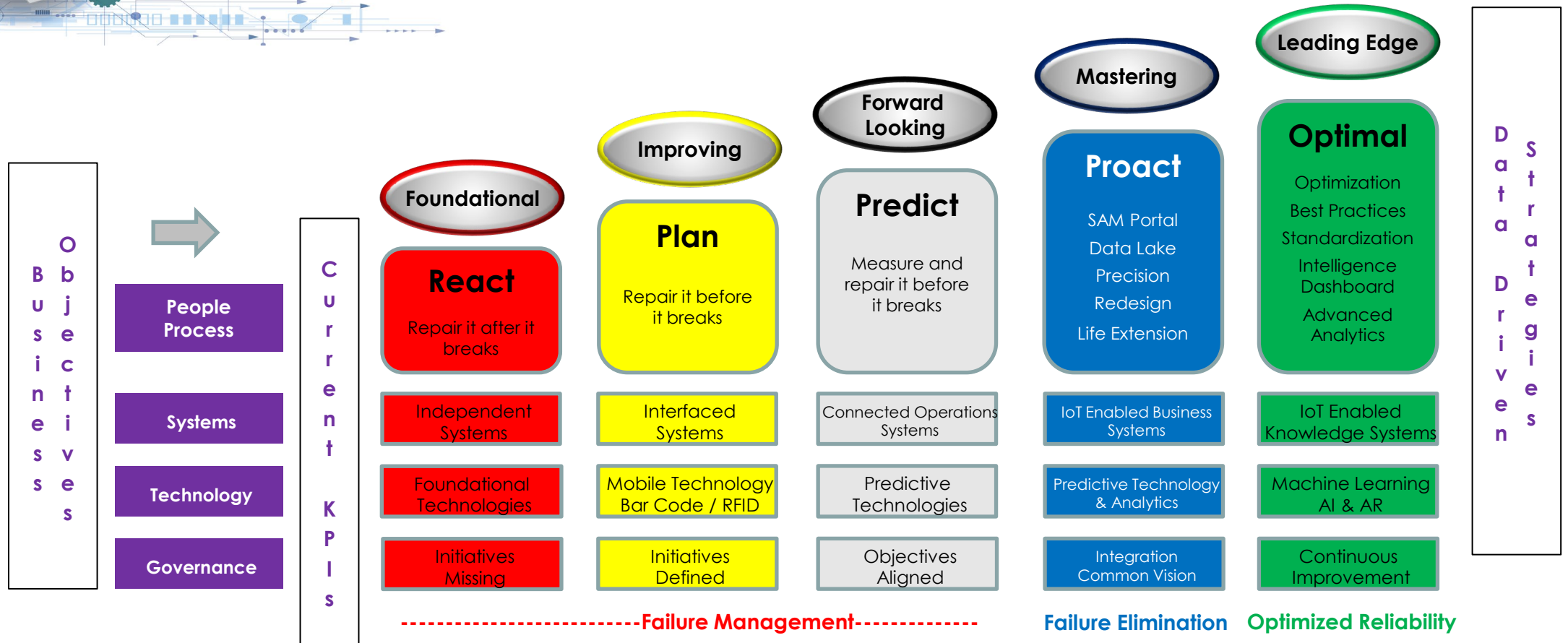




- The ePdM approach is focused on the desired result: improving reliability through failure elimination.
- Predictive technologies become the means to an end in this approach
- In an ePdM program, success is not measured by completing PdM tasks but by achieving key KPIs and returning true reliability gains
- Most PdM programs focus on the functional tactics: data collection, analysis and reporting
 - Resulting in detecting and managing failures - Good
 - What gets less attention is establishing program metrics/KPIs, ROI, or tracking other long-term successes – Improvement Opportunity
 - Most programs typically, focus on completing tasks on a regular and timely basis and less on performance metrics – Improvement Opportunity

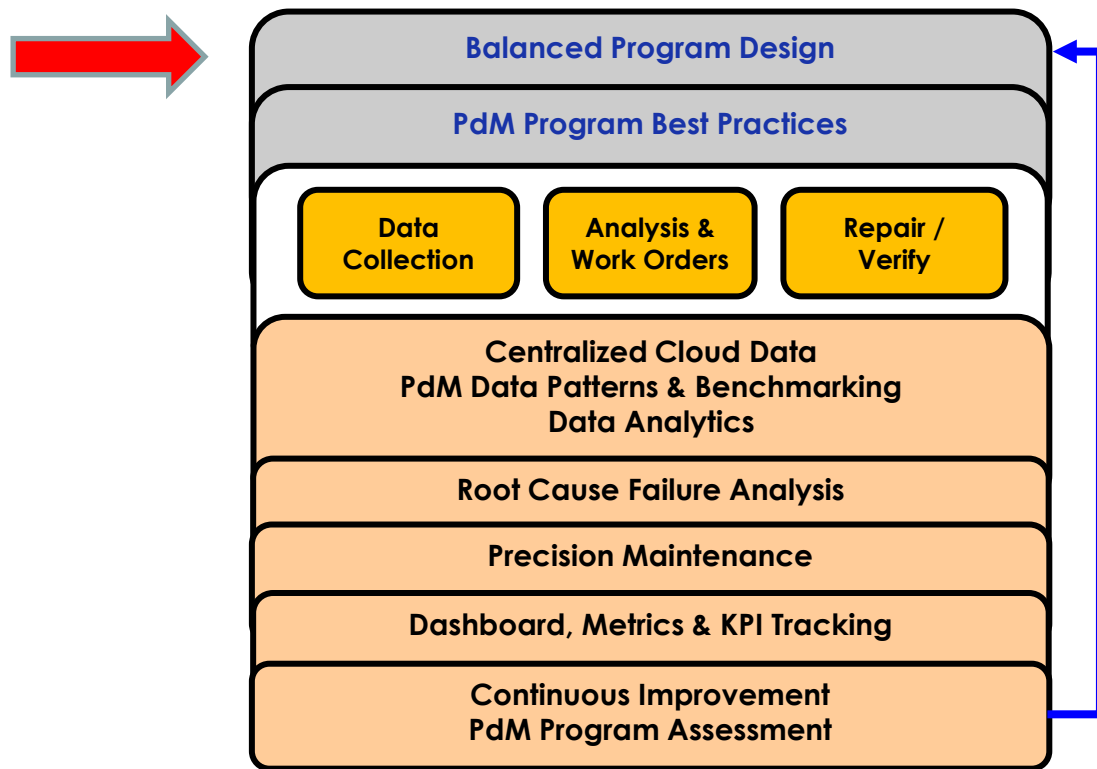


First step – determine current state & strategy forward



Asset Performance Management Maturity Framework

Enhanced PdM (ePdM)



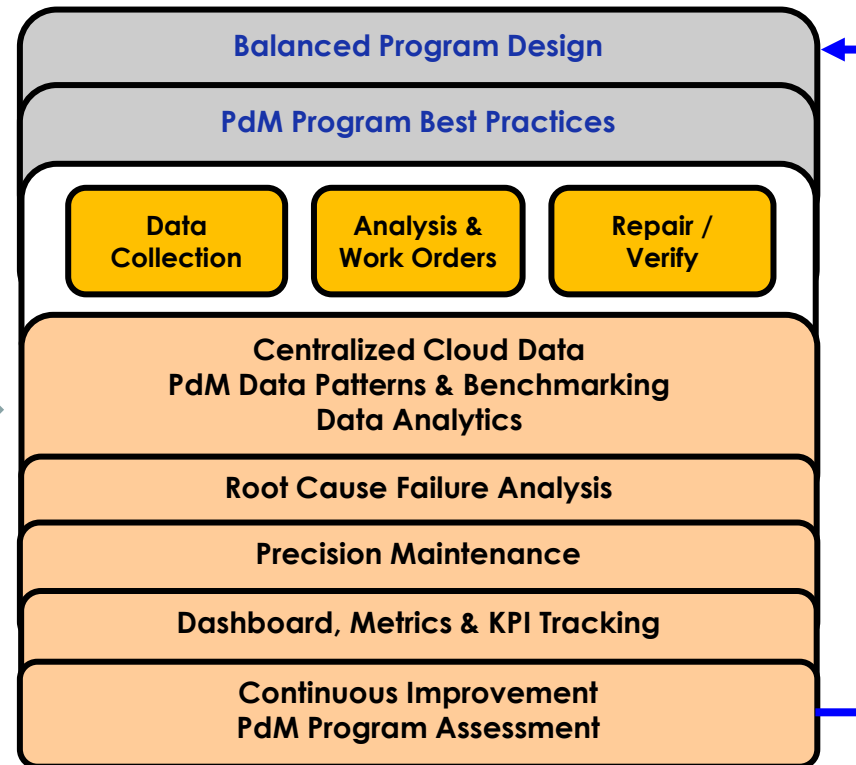
Balanced Design Criteria

- Asset Criticality Analysis
- Failure Mode Mitigation
- PdM Discipline Assignment
- Frequency Decision
- **Cost Justification**

**Failure/Loss Elimination
Cost Savings (Hard)**

Enhanced PdM (ePdM)

Tracking Failure Data



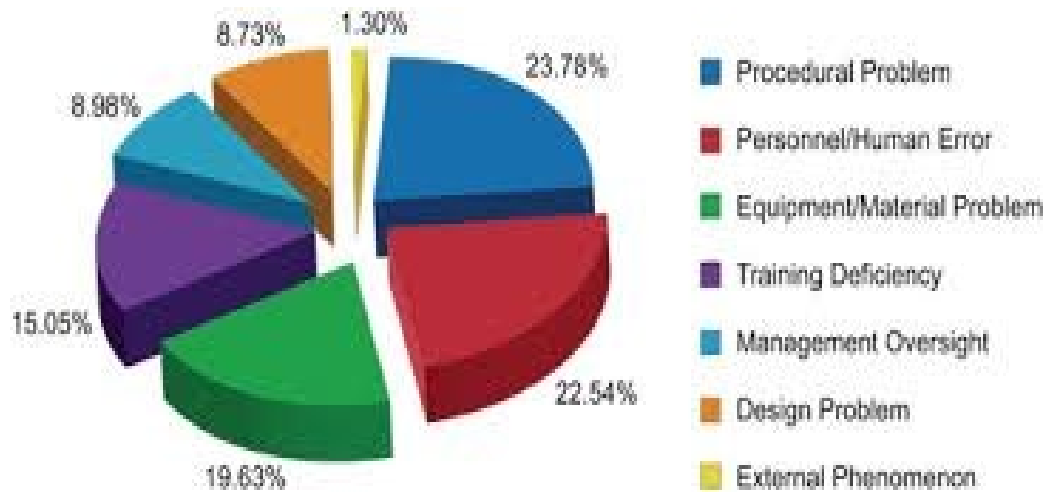
**Failure/Loss Elimination
Cost Savings (Hard)**

Trending PdM Failure Data

- Highly dependent on how PdM finds are reported and how the corrective action is initiated
- Use the CMMS to facilitate trending
- Establish work order types (CM, PM, PdM, etc.) to filter how the work is being identified
- Establish detailed failure codes that will be assigned to each work order
- Routinely query the system to trend and further root cause analysis of reoccurring patterns.

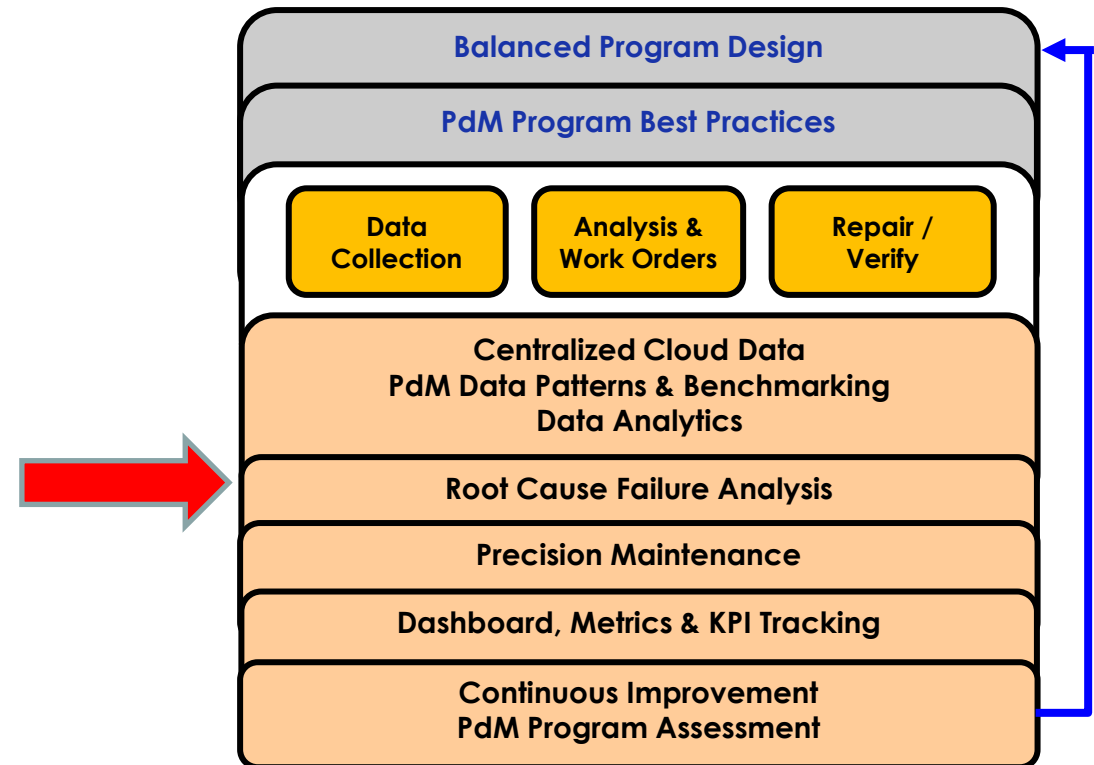
Code	Description (English)
0010	Blockage/Plugged
0020	Breakage
0030	Burst
0040	Cavitation
0050	Clearance / Alignment Failure
0060	Contamination
0070	Corrosion
0080	Cracked
0090	Deformation
0100	Dirty
0110	Erosion
0120	External Influences
0130	Fatigue
0140	Fouling
0150	Imbalance
0160	Improper Fit
0170	Improper Lubrication
0180	Incorrect Material
0190	Leakage
0200	Looseness
0210	Other (Explain in Detail)
0220	Overheating
0230	Sticking
0240	Vibration/Noise

A More Precise Approach



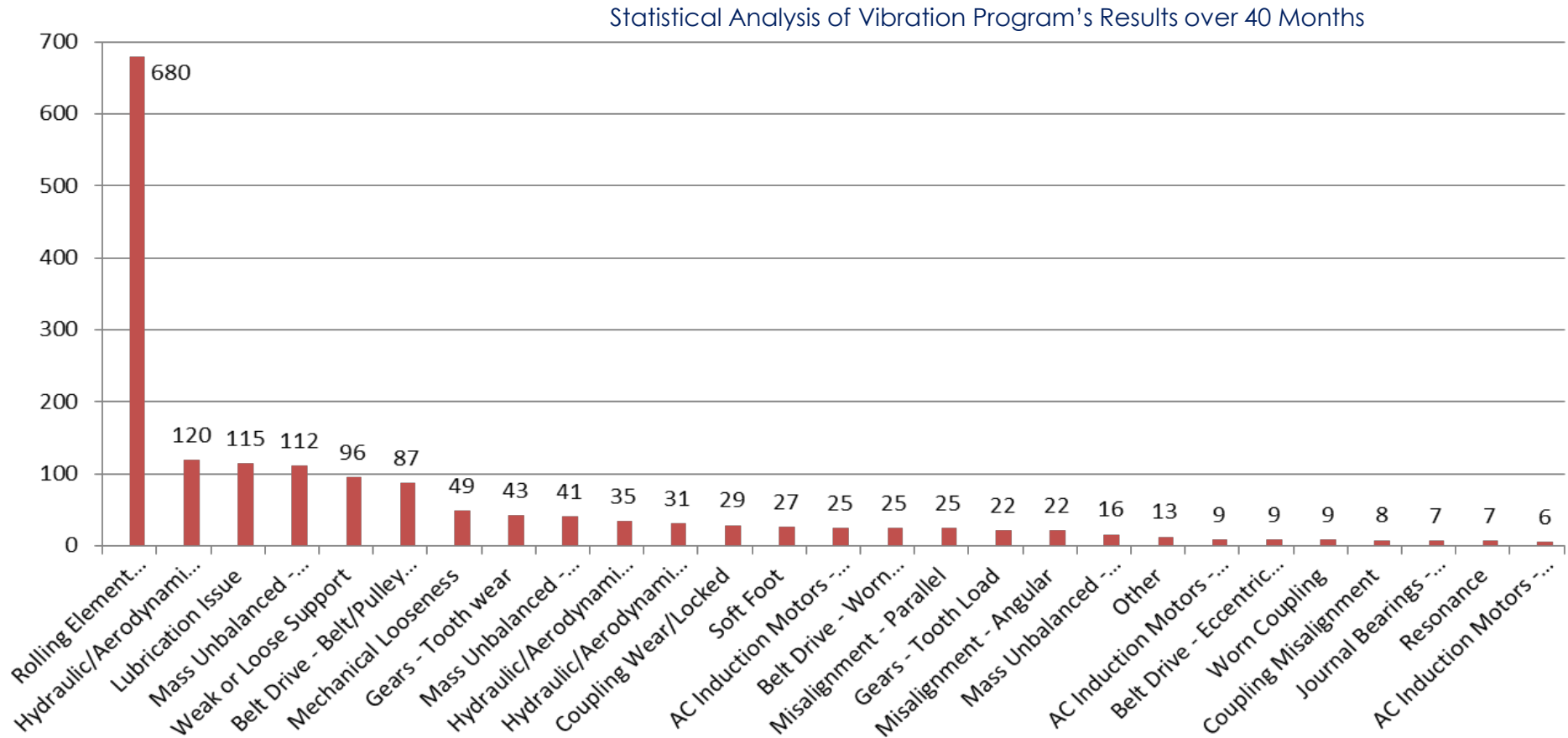
Machinery Lubrication, Survey

Readership survey of "What goes wrong in the factory" based upon the general failure cause categories outline in the U.S. DOE's root cause analysis standard (DOE-NE-1004-92). **The reply shows that equipment is to blame in less than 20 percent of the occurrences. Nearly 80 percent of what goes wrong can be attributed to people issues. Problems with procedures and training (combined) are responsible for nearly 40 percent. Personnel/human error constituted a little more than 22 percent of the vote. Management oversight represented about 9 percent. Also, design problems totaled roughly 9 percent.**

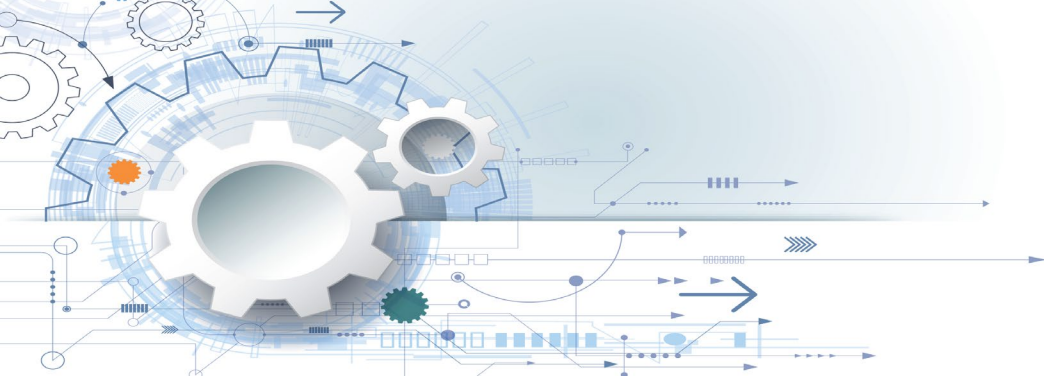


**Failure/Loss Elimination
Cost Savings (Hard)**

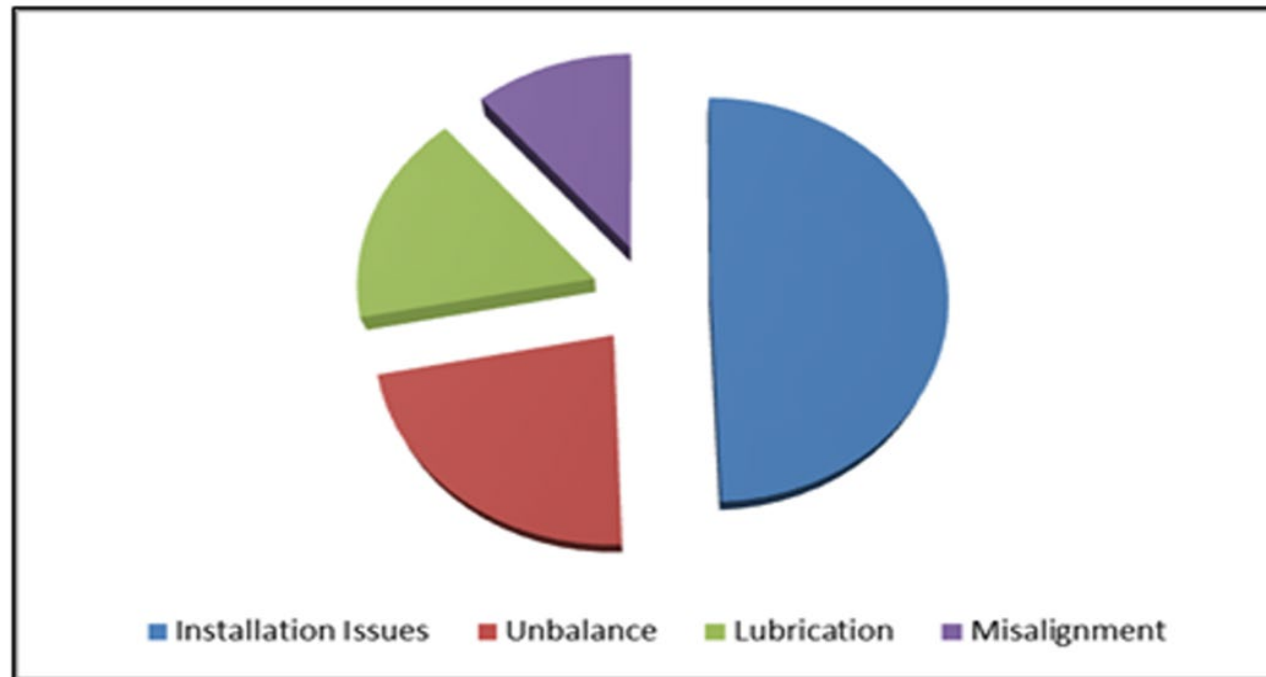
Example - reoccurring failure patterns



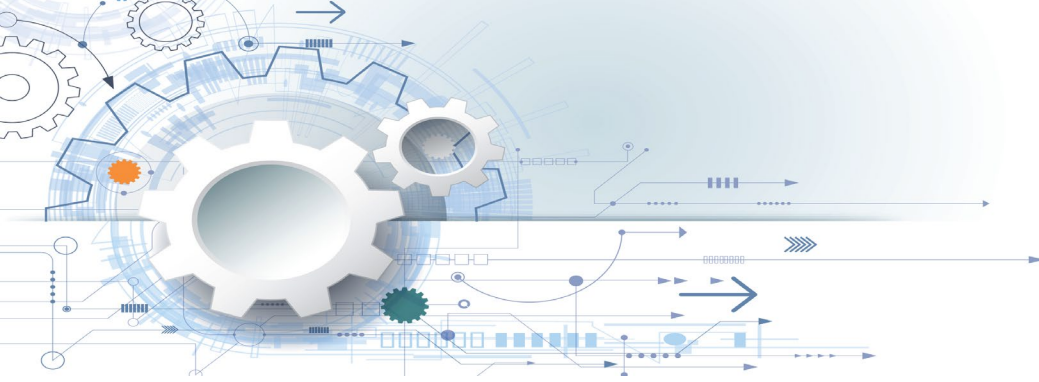
Example - reoccurring failure patterns



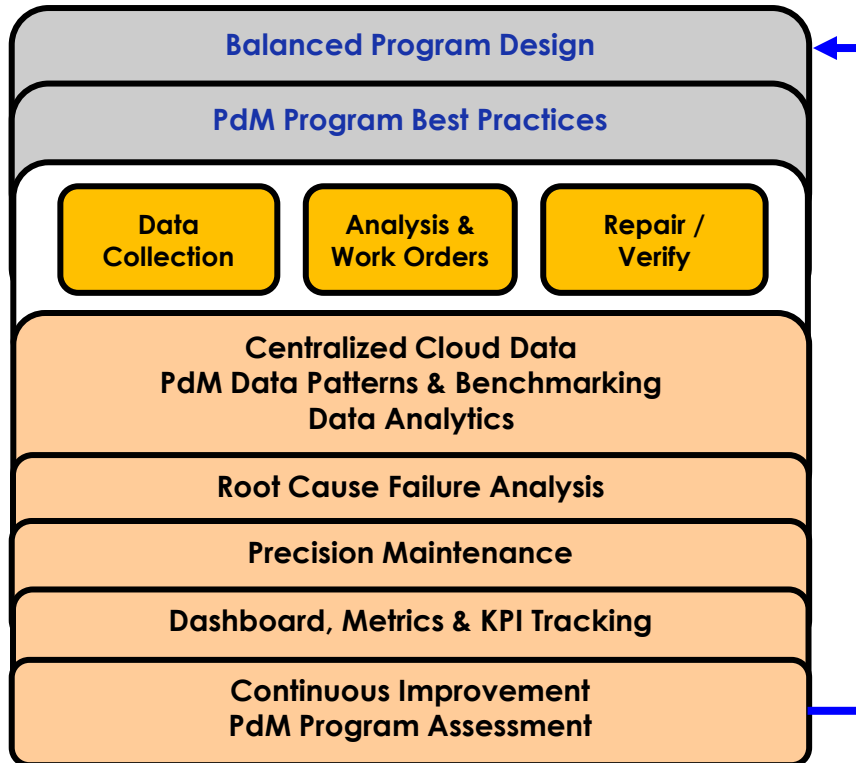
Root Cause Analysis Results of the top reoccurring failure – rolling element bearing faults



Example - reoccurring failure patterns



Precision Maintenance training for installation issues

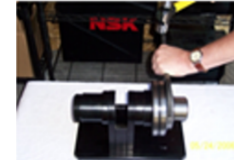


Handling Precautions:

- Store in Clean, dry area with minimal vibration
- Keep bearing in original packaging until needed
- Hands should be clean and dry
- Keep surrounding area clean
- Do not wash new bearings
- Keep bearings covered when not in use

Mounting Considerations:

- Use proper, unworn tools
- Clean shaft and housing
- Check shaft and housing dimensions
- Ensure proper alignment
- Support proper bearing ring
- Avoid impacts on bearing – no hammers



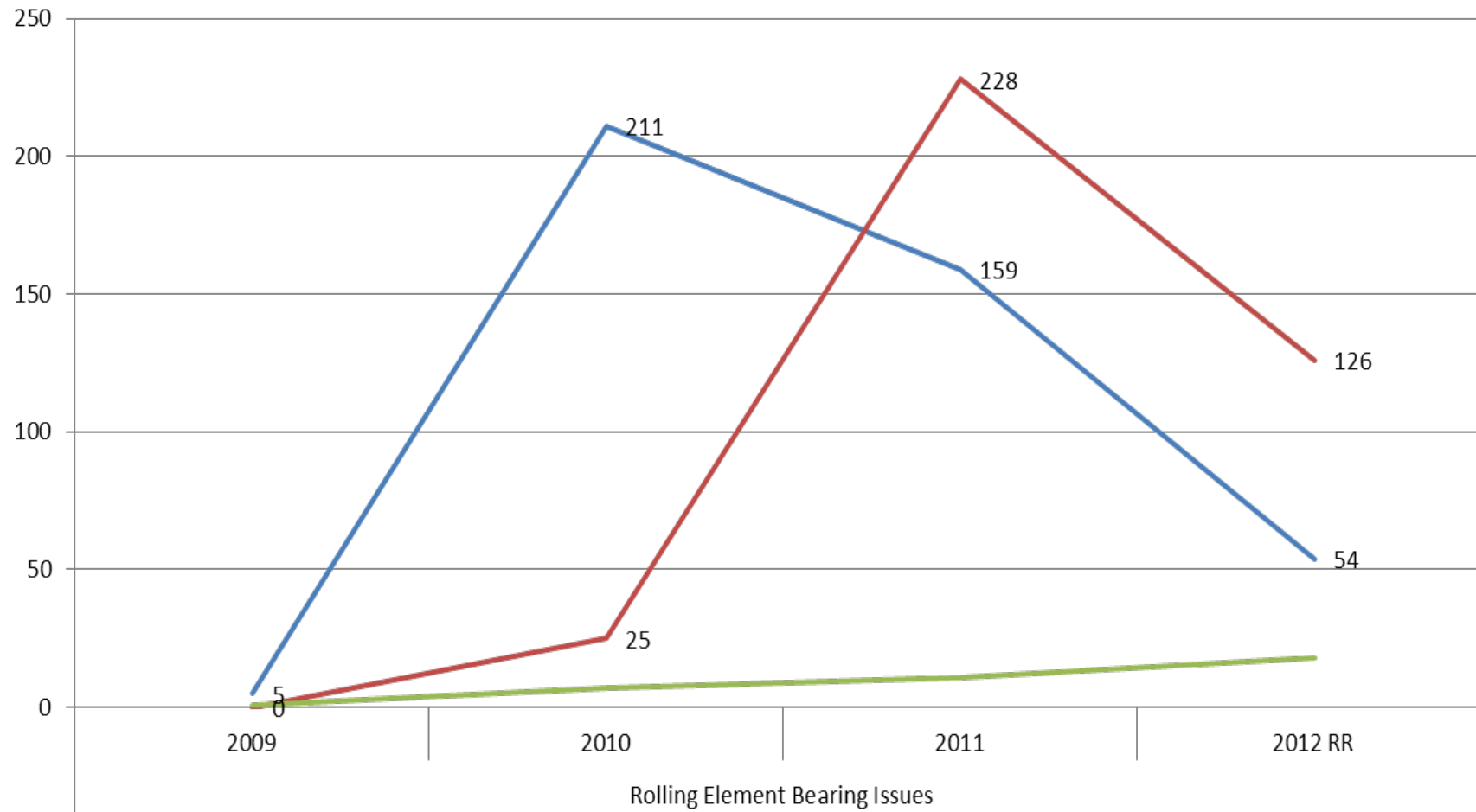
Torches
Hammers
Brass Rods



Failure/Loss Elimination
Cost Savings (Hard)

Example - reoccurring failure patterns

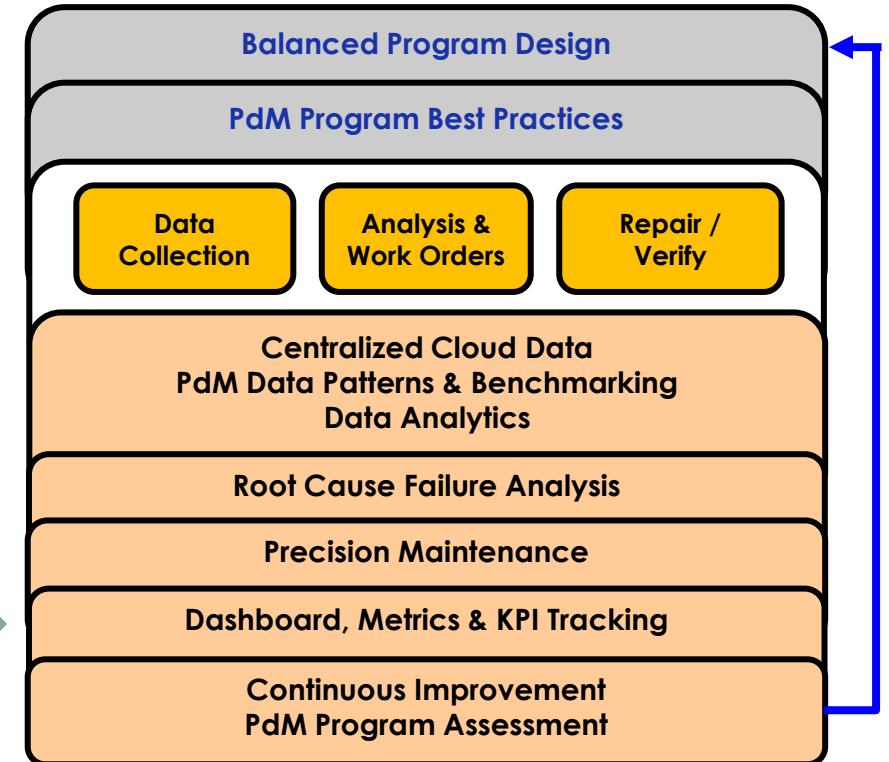
Resulting in a decline in reoccurring failures YOY, eliminating failures



Performance Management



- Goals should be aligned with overall business objects
- Focus on improved reliability
- PdM and work history results are fuel for reoccurring failure pattern tracking
- Remember, program compliance goals are important, eliminating failure patterns drives reliable operations



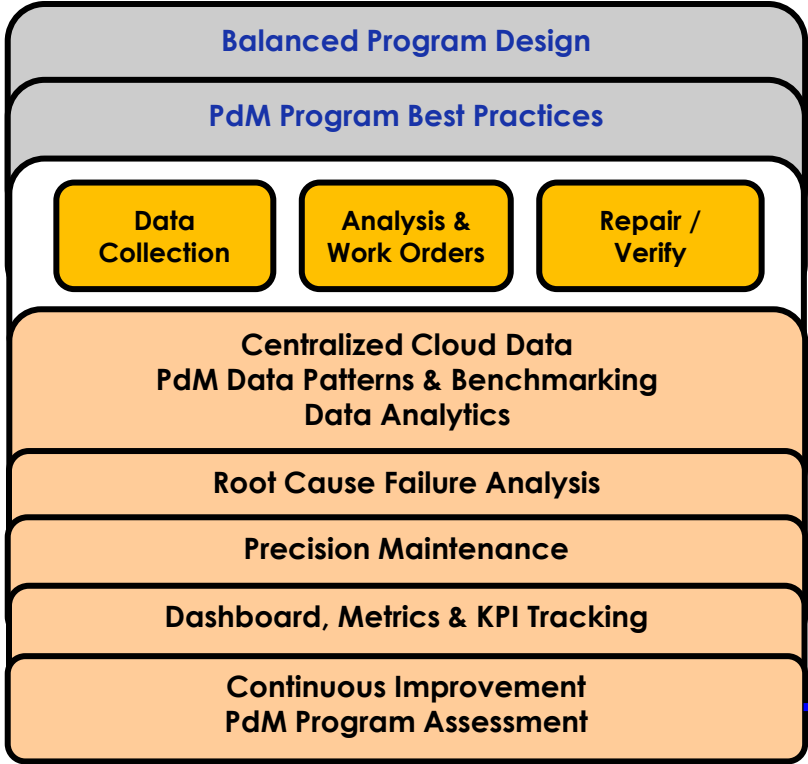
Failure/Loss Elimination
Cost Savings (Hard)

Continuous Improvement



Assessment Results Dashboard

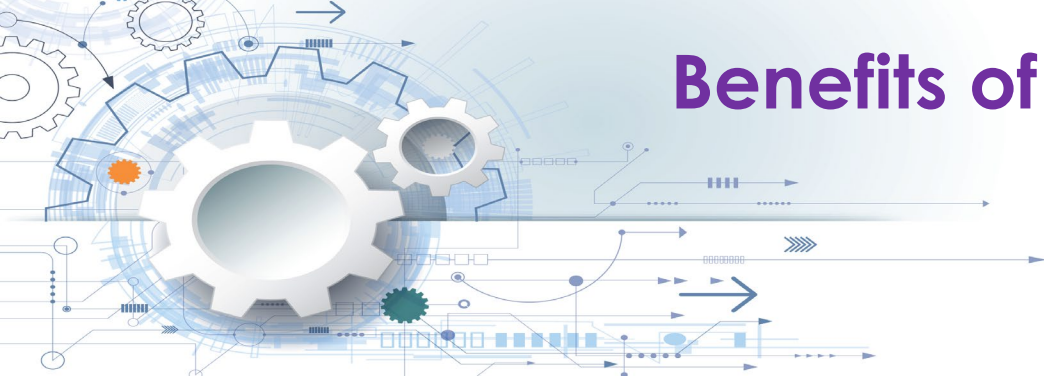
Program Management	Awareness & Site Support	Sharing Results (Communicating)	Continuous Improvement	Audit & Review	Resourcing
Measuring & Acting on Results	KPIs	Program Performance Metrics	Financial Performance Metrics	RCA Reducing Failures	Corrective Actions
Technology Application	Vibration	Ultrasound	Thermography	Oil Analysis	Other Technologies
Applying your Program	Data Collection	Analysis	Route Management	Non-Route Applications	Contractor Management
Setting up Program	Methodology for Choosing Equipment	Roles & Responsibilities / Stakeholders	Defined Goals & Processes	Training/Skills	Systems/CMMS Setup



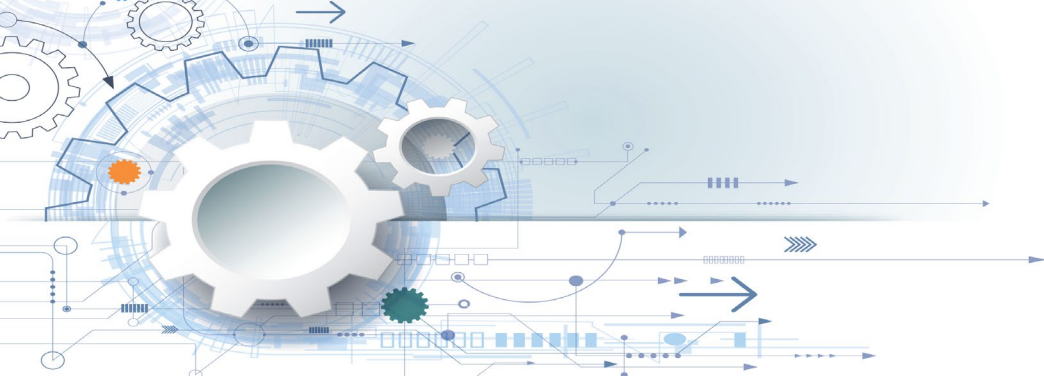
Failure/Loss Elimination
Cost Savings (Hard)



Benefits of enhancing your existing PdM with ePdM



- Enhances or creates additional value to the PdM investments
- Ensures your PdM efforts are focused on the value stream
- Enhances focus on failure elimination and overall reliability
- Increases planning & maintenance productivity
- Improves quality
- Improves safety
- Increases throughput / reduces downtime / MTBF
- Reduces emergency work
- Reduces PM events
- Reduces troubleshooting time / decreases MTTR
- ePdM will help facilities prepare for new approaches like IIoT, machine learning and predictive analytics by focusing on four key areas:
 - Doing the right things for the right reasons (design or optimization of new or existing programs)
 - Managing to set standards, processes and procedures to achieve KPIs and stated goals
 - Delivering high-quality analysis, reporting and statistical trending
 - Identifying reoccurring failure modes and applying RCFA techniques for corrective actions

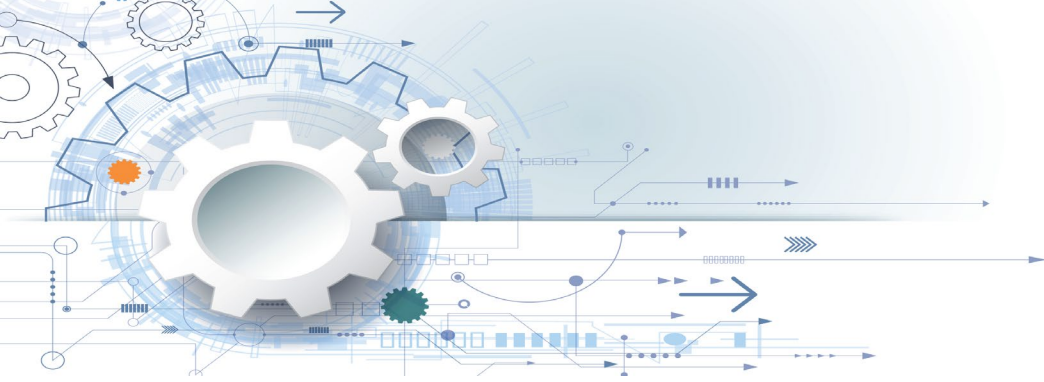


Enhanced Predictive Maintenance combines the time proven PdM / condition monitoring approach with Risk Based Asset Performance Management's "best practices" to achieve superior results quickly.

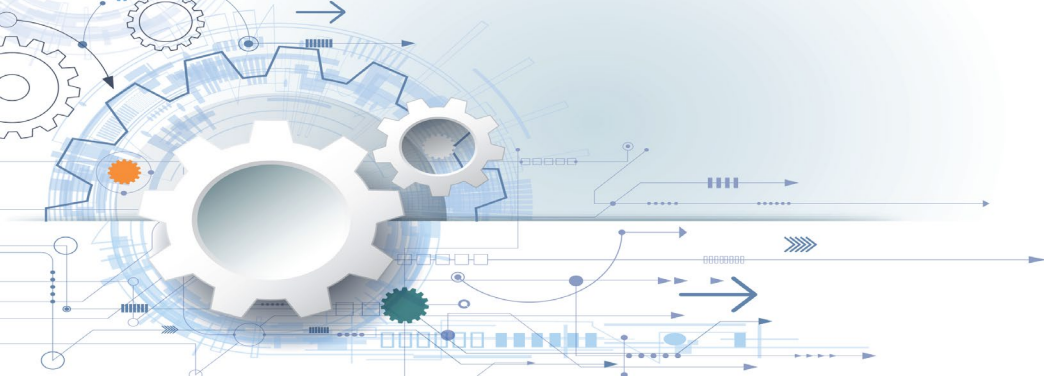
Combining traditional PdM program results with advanced trending and analytics, provides a means to move from failure management to failure elimination thus reducing cost avoidance in favor of cost savings.

The goal, where possible, is to detect and eliminate failure patterns at its root, reducing the reoccurring failures to create true long-term reliability, maximizing return on investment.

In addition, leveraging advances in technology, condition monitoring devices and cloud-based software, will allow for a unique platform to manage and improve operational and asset productivity across the enterprise asset base.



Questions?



John Pucillo - Principal, True Reliability

Reliability, Predictive Maintenance & Operation Consultant

Results-driven senior reliability, operation and product management professional with 40 years of successfully executing best-in-class delivery and product strategies to achieve business objectives. Experience in management, product development, deployment strategies, optimizing workflow to reduce inefficiencies and cost. Accomplished in pricing models, software development, website operations, product management, project management, and collaborating effectively with clients.





Thank You

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